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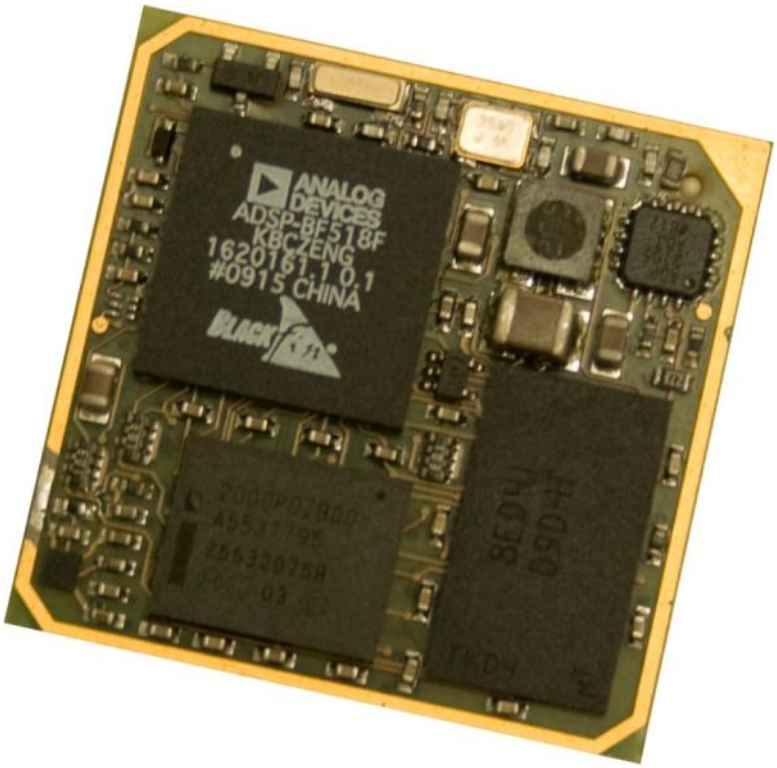

Hardware User Manual

TCM-BF518 V1.x

...maximum performance at minimum space

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The Core Modules and development systems contain ESD (electrostatic discharge) sensitive devices. Electro-static charges readily accumulate on the human body and equipment and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Unused Core Modules and Development Boards should be stored in the protective shipping

BLACKFIN Products

Core Modules:

TCM-BF518:	The new Core Module CM-BF518 is powered by Analog Devices' single core ADSP-BF518 processor; up to 400MHz, 32MB SDRAM, up to 8MB flash. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.
CM-BF527:	The new Blackfin Processor Module is powered by Analog Devices' single core ADSP-BF527 processor; key features are USB OTG 2.0 and Ethernet. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.
CM-BF533:	Blackfin Processor Module powered by Analog Devices' single core ADSP-BF533 processor; up to 600MHz, 32MB SDRAM, 2MB flash, 2x60 pin expansion connectors and a size of 36.5x31.5mm.
TCM-BF537:	Blackfin Processor Module powered by Analog Devices' single core ADSP-BF537 processor; up to 500MHz, 32MB SDRAM, 8MB flash, a size of 28x28mm, 2x60 pin expansion connectors, Ball Grid Array or Border Pads for reflow soldering, industrial temperature range -40°C to +85°C.
CM-BF537E:	Blackfin Processor Module powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated TP10/100 Ethernet physical transceiver, 2x60 pin expansion connectors and a size of 36.5x31.5mm.
CM-BF537U:	Blackfin Processor Module powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated USB 2.0 Device, 2x60 pin expansion connectors and a size of 36.5x31.5mm.
CM-BF548:	The new Blackfin Processor Module is powered by Analog Devices' single core ADSP-BF548 processor; key features are 64MB DDR SD-RAM 2x100 pin expansion connectors.
CM-BF561:	Blackfin Processor Module powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 64MB SDRAM, 8MB flash, 2x60 pin expansion connectors and a size of 36.5x31.5mm.
eCM-BF561:	Blackfin Processor Module powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 128MB SDRAM, 8MB flash, 2x100 pin expansion connectors and a size of 44x33mm.

Development Boards:

EVAL-BF5xx:	Low cost Blackfin processor Evaluation Board with one socket for any Bluetechnix Blackfin Core Module. Additional interfaces are available, e.g. an SD-Card.
DEV-BF5xxDA-Lite:	Get ready to program and debug Bluetechnix Core Modules with this tiny development platform including an USB-Based Debug Agent. The DEV-BF5xxDA-Lite is a low cost starter development system including a VDSP++ Evaluation Software License.
DEV-BF548-Lite:	Low-cost development board with one socket for Bluetechnix CM-BF548 Core Module. Additional interfaces are available, e.g. an SD-Card, USB and Ethernet.
DEV-BF548DA-Lite:	Get ready to program and debug Bluetechnix CM-BF548 Core Module with this tiny development platform including an USB-Based Debug Agent. The DEV-BF548DA-Lite is a low-cost starter development system including a VDSP++ Evaluation Software License.
EXT-Boards:	The following Extender Boards are available: EXT-BF5xx-AUDIO, EXT-BF5xx-VIDEO, EXT-BF5xx-CAM, EXT-BF5xx-EXP-TR, EXT-BF5xx-USB-ETH2, EXT-BF5xx-AD/DA, EXT-BF548-EXP and EXT-BF518-ETH. Furthermore, we offer the development of customized extender boards for our customers.

Software Support:

BLACKSheep:	The BLACKSheep VDK is a multithreaded framework for the Blackfin processor family from Analog Devices that includes driver support for a variety of hardware extensions. It is based on the real-time VDK kernel included within the VDSP++ development environment.
LabVIEW:	LabVIEW embedded support for Bluetechnix Core Modules is done by Schmid-Engineering AG: http://www.schmid-engineering.ch
uClinux:	All the Core Modules are fully supported by uClinux. The required boot loader and uClinux can be downloaded from: http://blackfin.uClinux.org.

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BLACKFIN Design Service

Based on more than five years of experience with Blackfin, Bluetechnix offers development assistance as well as custom design services and software development.

1 Introduction

The TCM-BF518 is a Core Module designed for consumer temperature range and volume production. It combines a power supply, RAM and FLASH memory in a small module with dimensions of 28x28mm.

1.1 Overview

Figure 1-1 shows the main components of the Core Module TCM-BF518.

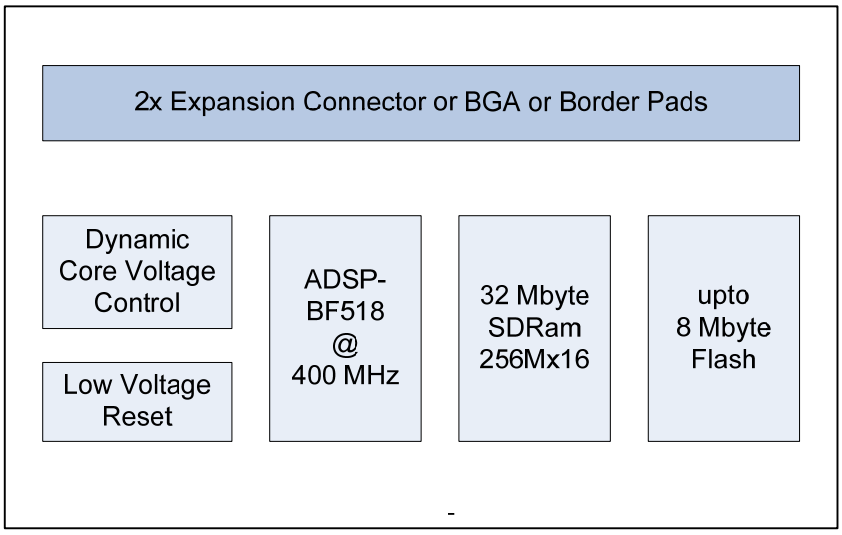

Figure 1-1: Main components of the TCM-BF518 Core Module

- **Blackfin Processor BF518 from Analog Devices**
  - ADSP-BF518KSWZ, 400MHz (0°C to +70°C)
- **32 MB SDRAM**
  - SDRAM Clock up to 133MHz
  - MT48LC16M16A2BG-7 (16Mx16, 256Mbit at 3.3 V)
- **8 MB of Byte Addressable Flash**
  - PF48F2000P0ZBQ0S (32Mx16, 2MByte directly addressable; all 8MByte addressable using external connection of A2x lines via GPIOs)
  - Additional flash memory upon request: It can be connected through the expansion board as parallel flash using asynchronous chip select lines or as SPI flash.
- **Low Voltage Reset Circuit**
  - Resets the module if the supply voltage drops below 2.93V.
- **Core Voltage Control**
  - Core voltage 1.35V (0.95V - 1.5V)
- **Peripherals available on all Core Module versions**
  - Power Supply
  - SPORT 0
  - JTAG
  - UART0/UART1
  - TWI (I2C compatible)

- SPI (Serial Port Interface)
- PPI (Parallel Port Interface)
- Boot Mode Pins
- GPIO's

- **Peripherals only available on the Connector and BGA version**
  - Data Bus
  - Address Bus
  - Further GPIO's
  - Memory Control Signals

1.2 Versions

TCM-BF518: Connector version 2x60 connector pins

1.3 Key Features

- Measuring only 28x28mm, the TCM-BF518 is the smallest available core module on the market.
- Allows integration on a two layer baseboard.
- Reduces development costs and time to market.
- Very cost effective for small and medium volumes.

1.4 Target Applications

- Generic high-performance signal processor module
- VoIP
- Industrial Control
- Motor Control
- Femto Cells
- Networked Audio
- Instrumentation

1.5 Further Information

Further information, and document updates are available on the product homepage: http://www.bluetechnix.com/goto/tcm-bf518

2 Specification

2.1 Functional Specification

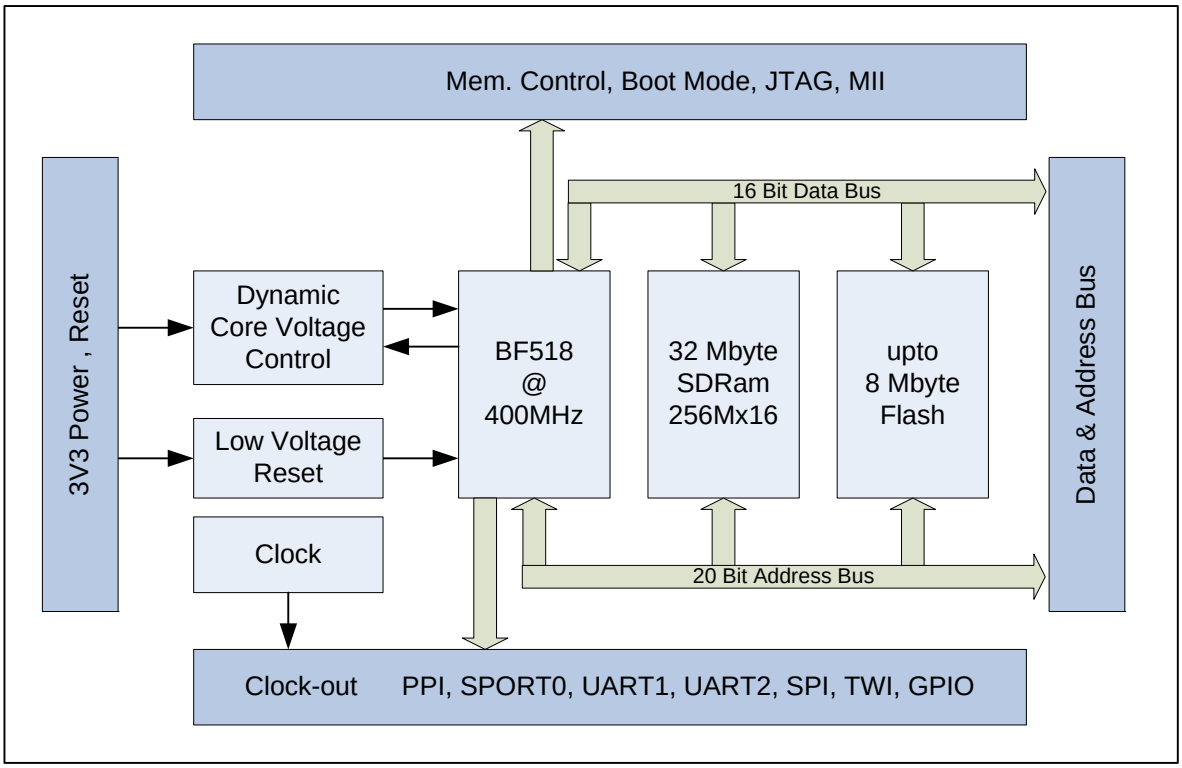

Figure 2-1: Detailed block diagram

Figure 2-1 shows a detailed block diagram of the TCM-BF518 module. Beside the SDRAM and a few other control pins, the TCM-BF518 has most pins of the Blackfin processor on its two 60-pin connectors, or its BGA, or its Border Pads.

A low voltage reset circuit guarantees a power on reset and resets the system when the input voltage drops below 2.93V for at least 140ms.

2.2 Boot Mode

By default the boot mode = 000 (BMODE2 = Low, BMODE1 = Low, BMODE0=Low). All BMODE pins have on board pull down resistors.

Switch Settings BM3,BM2,BM1,BM0	Boot Mode	Description
000	0	Idle - No boot
001	1	Boot from 8- or 16-bit external flash memory
010	2	Boot from internal SPI memory
011	3	Boot from external SPI memory (EEPROM or flash)
100	4	Boot from SPI0 host
101	5	Boot from OTP memory
110	6	Boot from SDRAM
111	7	Boot from UART0

Table 2-1: TCM-BF518 boot modes

Connect BMODE0 to Vcc and leave both BMODE1 and BMODE2 pins open to adjust Boot Mode 1. This is the default boot mode for the BLACKsheep software.

2.3 Core Module Memory Map

Type	Start Address	End Address	Size	Comment
FLASH *)	0x20000000	0x201FFFFF	2MB	¼ of 8MB Flash, PF48F2000P0ZBQ0S
SD-RAM	0x00000000	0x01FFFFFF	32MB	16 bit Bus Micron,MT48LC16M16A2FG

Table 2-2: Memory Map

*) Be aware that you have to unlock the flash before starting an erase process!

2.3.1 Asynchronous Memory Banks

The Blackfin processor can address a maximum of 1MB with a single asynchronous memory bank. On this module, each 2MB segment of flash is addressed using 2 asynchronous memory banks. In order to be able to use more than 2MB without using more than 2 banks, GPIOs can be used to select which 2MB section of the FLASH is visible in the memory window of the Blackfin processor. This frees up the remaining banks for the user. Address lines A20 - A24 of the flash are available on the connectors and can be connected to free GPIOs.

Bank	Start Address	End Address	Size	Comment
0	0x20000000	0x200FFFFF	1MB	(Addresses FLASH)
1	0x20100000	0x201FFFFF	1MB	(Addresses FLASH)

See Chapter 3.6, Flash Memory Extension P.

2.4 Electrical Specification

2.4.1 Supply Voltage

- 3.3V DC +/-10%

2.4.2 Supply Voltage Ripple

- 100mV peak to peak 0-20 MHz

2.4.3 Input Clock Frequency

- 25MHz
  The Blackfin processor's input clock frequency is 25 MHz. This frequency is derived from the on-board crystal/oscillator and drives the Blackfin processor's clock generator. This frequency is also made available on the connector Pin 78 (CLKBUF).

2.4.4 Real Time Clock Crystal

- 32.768kHz

2.4.5 Supply Current

- Maximum current: 200mA at 3.3V
- Typical operating conditions at 25°C environment temperature:
  - Processor running at 400MHz, Core Voltage 1.35V, SDRAM 50% bandwidth utilization at 80MHz; 140mA at 3.3V.

2.5 Environmental Specification

2.5.1 Temperature

- Operating -0℃ to + 70℃ at 400MHz

2.5.2 Humidity

- Operating: 10% to 90% (non condensing)

3 TCM-BF518C (Connector Version)

3.1 Mechanical Outline

Figure 3-1 shows the top view of the Core Module. All dimensions are given in millimeters!

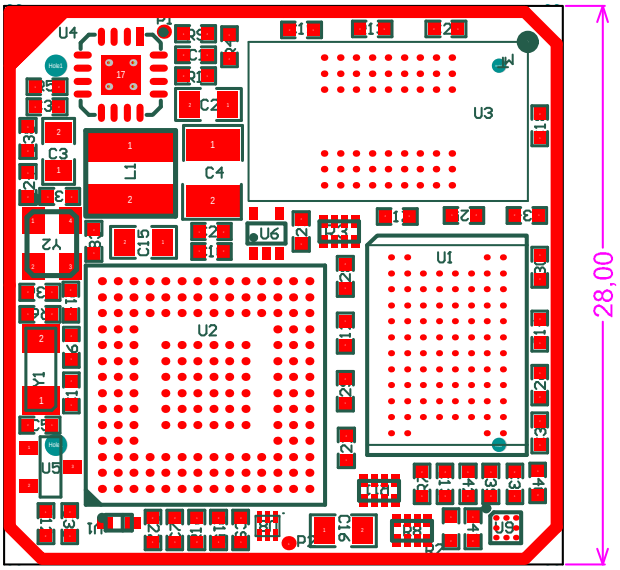

Figure 3-1: Mechanical Outline (**top view**)

Figure 3-2 shows the bottom view of the Core Module (connector version).

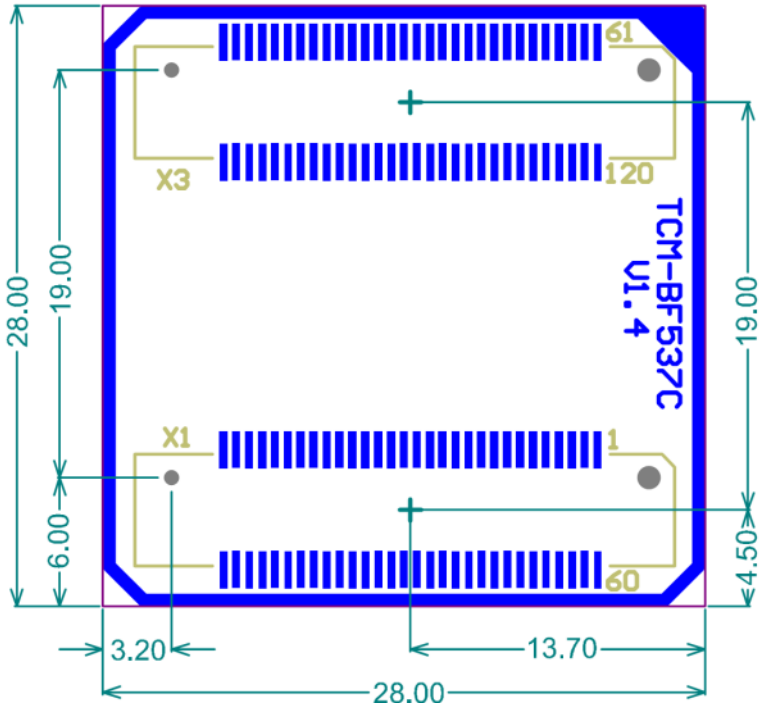

Figure 3-2: Mechanical Outline (**bottom view**)

Figure 3-3 shows a side view of the Core Module with mounted connectors.

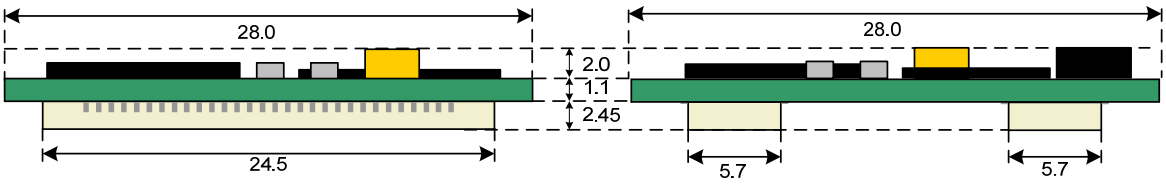

Figure 3-3: Side view with mounted connectors

The total minimum mounting height including receptacle at the baseboard is 5.8mm.

3.2 Footprint

The baseboard's footprint for the Connector version (2x Hirose 0.6mm pitch) is shown in Figure 3-4.

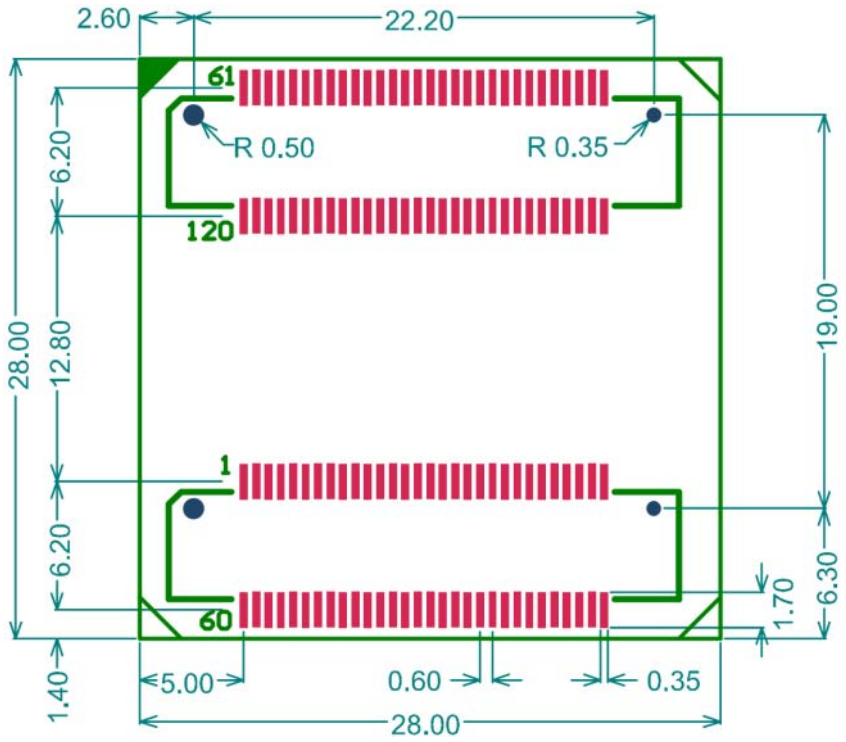

Figure 3-4: Recommended footprint for the baseboard (**top view**)

For the baseboard the following connectors have to be used.

Baseboard Part	Manufacturer	Manufacturer Part No.
X1, X2	Hirose	FX8-60S-SV

Table 3-1: Baseboard connector types

The Connectors on the TCM-BF518 are of the following type:

Part	Manufacturer	Manufacturer Part No.
X1, X2	Hirose 3mm height	FX8-60P-SV

Table 3-2: Core Module connector types

3.3 Schematic Symbol of Connector Version

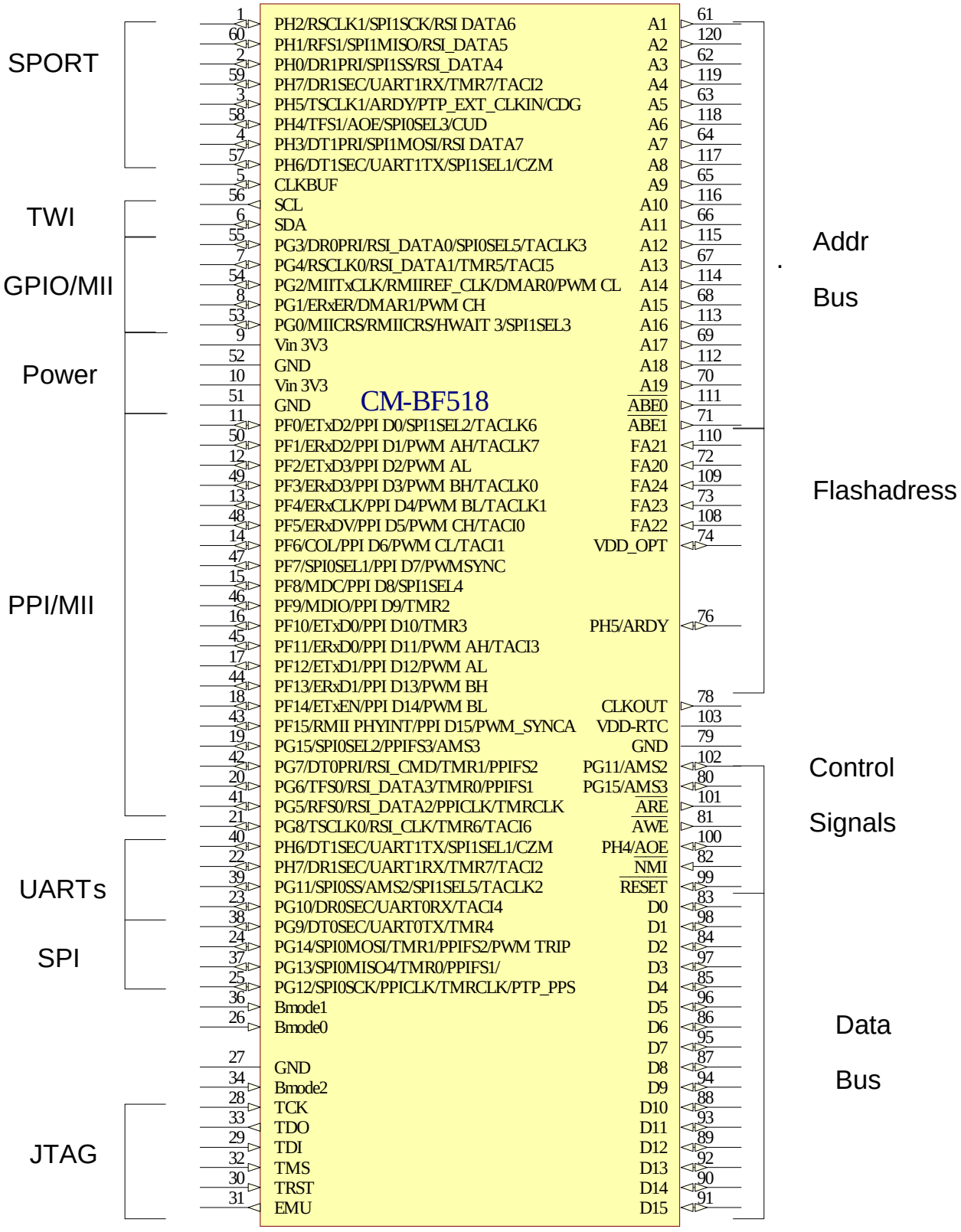

Figure 3-5: Schematics symbol of the TCM-BF518 Connector version

3.4 Connector Pin Assignments

3.4.1 Connector X1 – (1-60)

Pin No.	Signal	Signal Type.
1	PH2/RSCLK1/SPI1SCK/RSI DATA6	I/O
2	PH0/DR1PRI/SPI1SS/RSI_DATA4	I/O
3	PH5/TSCLK1/ARDY/PTP_EXT_CLKIN/CDG	I/O
4	PH3/DT1PRI/SPI1MOSI/RSI DATA7	I/O
5	CLKBUF	I/O
6	SDA	I/O
7	PG4/RSCLK0/RSI_DATA1/TMR5/TACI5	I/O
8	PG1/ERxER/DMAR1/PWM CH	I/O
9	Vin 3V3	Power
10	Vin 3V3	Power
11	PF0/ETxD2/PPI D0/SPI1SEL2/TACLK6	I/O
12	PF2/ETxD3/PPI D2/PWM AL	I/O
13	PF4/ERxCLK/PPI D4/PWM BL/TACLK1	I/O
14	PF6/COL/PPI D6/PWM CL/TACI1	I/O
15	PF8/MDC/PPI D8/SPI1SEL4	I/O
16	PF10/ETxD0/PPI D10/TMR3	I/O
17	PF12/ETxD1/PPI D12/PWM AL	I/O
18	PF14/ETxEN/PPI D14/PWM BL	I/O
19	PG15/SPI0SEL2/PPIFS3/AMS3	I/O
20	PG6/TFS0/RSI_DATA3/TMR0/PPIFS1	I/O
21	PG8/TSCLK0/RSI_CLK/TMR6/TACI6	I/O
22	PH7/DR1SEC/UART1RX/TMR7/TACI2	I/O
23	PG10/DR0SEC/UART0RX/TACI4	I/O
24	PG14/SPI0MOSI/TMR1/PPIFS2/PWM TRIP	I/O
25	PG12/SPI0SCK/PPICLK/TMRCLK/PTP_PPS	I/O
26	Bmode0	I - 10k pull down
27	GND	Power
28	TCK	I - 10k pull up
29	TDI	I - 10k pull up
30	TRST	I - 4k7 pull down
31	EMU	O
32	TMS	I - 10k pull up
33	TDO	O
34	Bmode2	I - 10k pull down
35	nc	
36	Bmode1	I - 10k pull down
37	PG13/SPI0MISO4/TMR0/PPIFS1/	I/O
38	PG9/DT0SEC/UART0TX/TMR4	I/O
39	PG11/SPI0SS/AMS2/SPI1SEL5/TACLK2	I/O
40	PH6/DT1SEC/UART1TX/SPI1SEL1/CZM	I/O
41	PG5/RFS0/RSI_DATA2/PPICLK/TMRCLK	I/O
42	PG7/DT0PRI/RSI_CMD/TMR1/PPIFS2	I/O
43	PF15/RMII PHYINT/PPI D15/PWM_SYNCA	I/O

44	PF13/ERxD1/PPI D13/PWM BH	I/O
45	PF11/ERxD0/PPI D11/PWM AH/TACI3	I/O
46	PF9/MDIO/PPI D9/TMR2	I/O
47	PF7/SPI0SEL1/PPI D7/PWMSYNC	I/O
48	PF5/ERxDV/PPI D5/PWM CH/TACI0	I/O
49	PF3/ERxD3/PPI D3/PWM BH/TACLK0	I/O
50	PF1/ERxD2/PPI D1/PWM AH/TACLK7	I/O
51	GND	Power
52	GND	Power
53	PG0/MIICRS/RMIICRS/HWAIT 3/SPI1SEL3	I/O
54	PG2/MIITxCLK/RMIIREF_CLK/DMAR0/PWM CL	I/O
55	PG3/DR0PRI/RSI_DATA0/SPI0SEL5/TACLK3	I/O
56	SCL	O
57	PH6/DT1SEC/UART1TX/SPI1SEL1/CZM	I/O
58	PH4/TFS1/AOE/SPI0SEL3/CUD	I/O
59	PH7/DR1SEC/UART1RX/TMR7/TACI2	I/O
60	PH1/RFS1/SPI1MISO/RSI_DATA5	I/O

Table 3-3: Connector X1 pin assignment

Signal names correspond to those of the Blackfin processor unless otherwise stated.

3.4.2 Connector X2 – (61-120)

Pin No.	Signal	Signal Type.
61	A1	O
62	A3	O
63	A5	O
64	A7	O
65	A9	O
66	A11	O
67	A13	O
68	A15	O
69	A17	O
70	A19	O
71	A\B\E\1\	O
72	FA20	I - 10k pull down
73	FA23	I - 10k pull down
74	VDD_OPT	I/O
75	nc	
76	PH5/ARDY	I/O
77	nc	
78	CLKOUT	O
79	GND	Power
80	PG15/AMS3	O
81	A\W\E\	O
82	N\M\I\	I
83	D0	I/O
84	D2	I/O

85	D4	I/O
86	D6	I/O
87	D8	I/O
88	D10	I/O
89	D12	I/O
90	D14	I/O
91	D15	I/O
92	D13	I/O
93	D11	I/O
94	D9	I/O
95	D7	I/O
96	D5	I/O
97	D3	I/O
98	D1	I/O
99	R\E\S\E\T\	I/O
100	PH4/AOE	I/O
101	A\R\E\	O
102	PG11/AMS2	I/O
103	VDD-RTC	Power
104	nc	
105	nc	
106	nc	
107	nc	
108	FA22	I - 10k pull down
109	FA24	I - 10k pull down
110	FA21	I - 10k pull down
111	A\B\E\0\	O
112	A18	O
113	A16	O
114	A14	O
115	A12	O
116	A10	O
117	A8	O
118	A6	O
119	A4	O
120	A2	O

Table 3-4: Connector X2 pin assignment

Signal names correspond to those of the Blackfin processor unless otherwise stated.

3.5 Reset circuit

The reset signal of the flash and the processor are connected to a power monitoring IC. The output can be used as power on reset for external devices, see Figure 3-6.

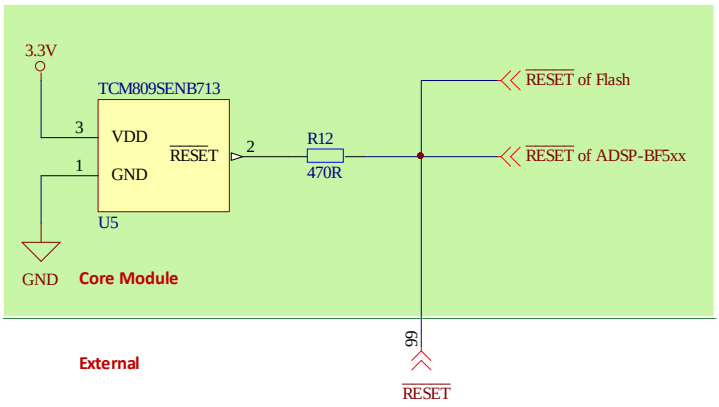

Figure 3-6: Schematic of reset circuit on the Core Module

If reset inputs of other devices are connected to the external RESET pin, an additional driver should be used.

3.6 Flash Memory Extension Pins

3.6.1 Pins FA20 to FA24

These pins are the address lines A20 (FA20) to A24 (FA24) of the Intel P30 Flash and are pulled down by default.

4 Application Example Schematics

In the following, examples are given how a Physical Ethernet chip and a USB 2.0 chip are connected to the Core Module.

4.1 Schematic Example for Connecting a Physical Ethernet Chip

The ADSP-BF518 from Analog Devices already integrates the Ethernet functionality. In order to use the Ethernet feature, a Physical Ethernet chip needs to be connected to the TCM-BF518 Core Module.

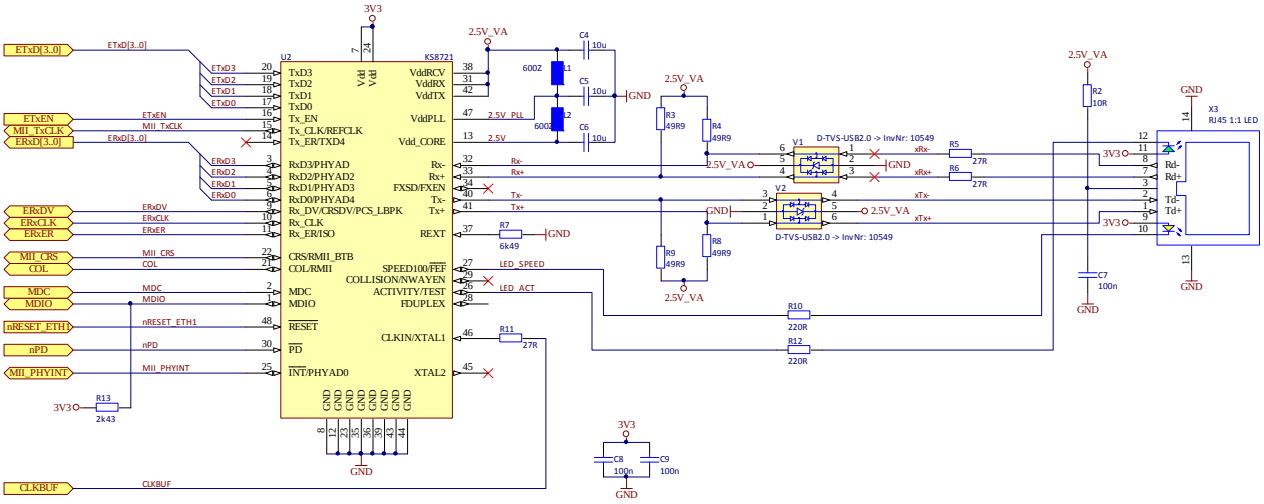

Figure 4-1: Connection of the Physical Ethernet chip with the Core Module

Designator	Value	Part Number	Description	Quantity
C1, C7, C8, C9, C10, C11, C12	100n	2238 246 19876	Capacitor non-polarized	7
C2, C4, C5, C6	10u	C0805C106K9PAC	Capacitor non-polarized	4
C13	100p	2238 867 15101	Capacitor non-polarized	1
L1	2200Z	742792693	Ferrite	1
R2	10R	MC 0.063W 0603 1% 10R	Resistor	1
R3, R4, R8, R9	49R9	MC 0.063W 0603 1% 49R9	Resistor	4
R7	6k49	MC 0.063W 0603 1% 6K49	Resistor	1
R10, R12	220R	MC 0.063W 0603 1% 220R	Resistor	2
R11	27R	MC 0.063W 0603 1% 27R	Resistor	1
R13	10k	MC 0.063W 0603 1% 10K	Resistor	1
U1		KSZ8041NL	10/100BASE Physical Layer	1
V1, V2		USBLC6-2P6	TSV-Diode for USB 2.0	2
X3		RJLBC-060TC1	RJ45-Connector with LEDs	1

Table 4-1: Bill of material of the sample schematic

4.2 Schematic Example for Connecting a USB 2.0 Chip

The following example shows how to connect a USB 2.0 chip to the TCM-BF518 Core Module.

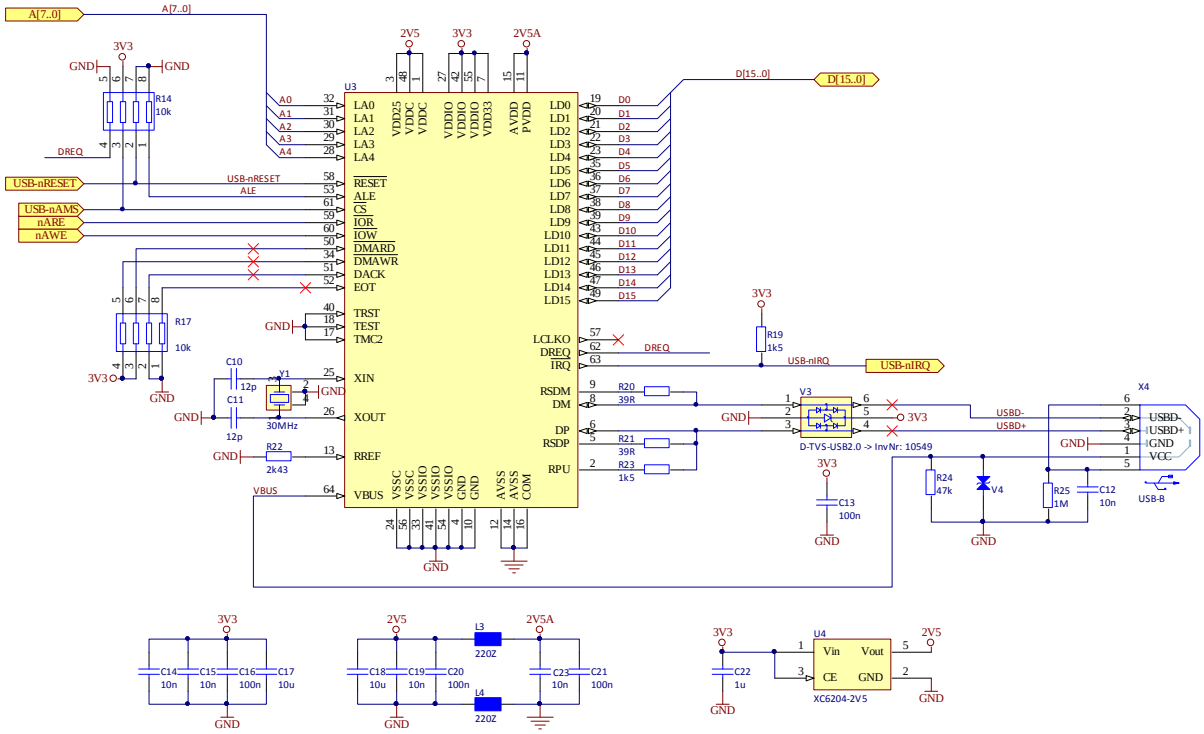

Figure 4-2: Connection of the USB 2.0 chip with the Core Module

Designator	Value	Part Number	Description	Quantity
C1u, C2u	12p	2238 867 15129	Capacitor non-polarized	2
C3u, C4u, C5u, C9u, C11u	10n	2238 916 15636	Capacitor non-polarized	5
C6u, C10u, C12u	100n	2238 246 19876	Capacitor non-polarized	3
C7u, C8u	10u	C0805C106K9PAC	Capacitor non-polarized	2
L1u, L2u	220R	74279263	Ferrite	2
R1u, R3u, R11u, R12u	10k	MC 0.063W 0603 1% 10K	Resistor	4
R2u	10k	2350 025 11003	4-Resistor Array	1
R4u	1k	MC 0.063W 0603 1% 1k	Resistor	1
R5u, R6u	39R	MC 0.0654W 0603 1% 39R	Resistor	2
R7u	2k43	MULTICOMP	Resistor	1
R8u	1k5	MC 0.063W 0603 1% 1K5	Resistor	1
R9u	47k	MC 0.063W 0603 1% 47k	Resistor	1
R10u	1M	MC 0.063W 0603 1% 1M	Resistor	1
U1u		NET2272REV1A-LF	USB 2.0 Peripheral Controller TQPF	1
V1u		CDS3C05GTA		1
X1u		2411 01	USB-Device Normal	1
Y1u		Q 30.0-JXS32-12-10/20	Crystal Oscillator	1

Table 4-2: Bill of Material of Sample Schematic

5 Software Support

5.1 BLACKSheep

The Core Module is delivered with a pre-flashed BLACKSheep VDK multithreaded framework. It contains a boot-loader for flashing the Core Module via the serial port.

Please consult the software development documents for further information.

5.2 uClinux

The Core Module is fully supported by the open source platform at http://blackfin.uclinux.org. Since the Core Modules are pre-flashed with BLACKSheep you have to flash uBoot first. You can use the BLACKSheep boot-loader for flashing uBoot.

In order to use the Ethernet functionality of the TCM-BF518 Core Modules, you need the EXT-BF518-ETH Blackfin Extension Board.

6 Anomalies

For the latest information regarding product anomalies, please consult the product home page:

http://www.bluetechnix.com/goto/tcm-bf518

Date	Revisions	Description

Table 8-1: Anomalies

7 Production Report

7.1 TCM-BF518 (100-1261)

Version	Component	Type
V1.0.1	Processor	ADSP-BF518KBCZ-4X 0.1
	RAM	MT48LC16M16A2BG-75 IT:D
	FLASH	PF48F2000P0ZBQ0

Table 9-1: Production Report TCM-BF518

8 Product Changes

For the latest product change information please consult the product web-page at:

http://www.bluetechnix.com/goto/tcm-BF518

Version	Changes
V1.0	Border Pad and BGA Versions added with 64MB flash addressing option, 28mmx28mm outline

9 Document Revision History

Version	Date	Document Revision
3	2010 06 28	Figure 3.5 updated
2	2010 01 26	Layout
1	2009 12 03	First release V1.0 of the Document

Table 9-1: Revision History

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